Producing 'greener' grass with legumes enhances $u$tainability

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Abstract: *Global concerns about increasing levels of atmospheric carbon dioxide mean that the nitrogen needs of pastures will increasingly need to be met through nitrogen fixation by legumes. Recent research on the Northern Tablelands of NSW shows that deep-rooted, fertilizer-responsive perennial grasses combined with legumes provide multiple environmental, production and financial benefits compared to pastures based on grasses alone.*

Key words: *Nitrogen fertilizer, soil water, carbon dioxide, sustainability, phalaris, white clover*

Introduction to the problem

Low or declining prices for ruminant livestock products such as milk, meat and wool constrain the profitability of livestock enterprises. At the same time, the recent extraordinary rise in the price of fertiliser makes it more challenging to cost-effectively produce feed for ruminants. The theme of this Conference "The Grass is Greener" is suggestive of some of the beef and dairy pastures of the high rainfall mid-north coast of New South Wales. This green grass is largely the product of short-term ryegrass-based pastures which require costly inputs such as frequent re-sowing and the application of nitrogenous fertiliser.

In contrast to the recent wet seasons on the coast, many parts of the State are still battling dry and dead pastures in drought affected areas. In addition, on the Tablelands during winter, pregnant livestock find their high nutritional needs at this time to be poorly met by pastures dominated by frosted, warm-season grasses of low quality with low value annual grasses and few legumes.

Currently, there is widespread concern as global atmospheric carbon dioxide levels increase towards 400 parts per million (ppm) (Anonymous 2009); this increase is fuelled, in part, by the energy consumed during the manufacture of nitrogen fertilisers such as urea. It is notable that, whilst many of our soils contain less that 30 ppm of soil nitrogen, the Earth's atmosphere contains 780,000 ppm of valuable nitrogen!

This paper summarises some research conducted on the Northern Tablelands published over the past 10 years which helps explain why maintaining both persistent legumes and deep-rooted, fertiliser-responsive, perennial grasses improves the sustainability and profitability of pasture-fed livestock enterprises.

What the research has shown

A trial aimed at quantifying the sustainability of pastures was conducted between 1994 and 1997 on the Northern Tablelands of NSW on 27 year-old perennial pastures. These pastures were either degraded through over grazing or were phalaris (*Phalaris aquatica*) dominant after loss of the original white clover (*Trifolium repens*) (Scott *et al.* 2000). A third treatment saw the re-introduction of white clover, by direct drilling in autumn 1994, into phalaris dominant paddocks after 'checking' the phalaris with a low rate of knockdown herbicide.

An index of sustainability showed increased productivity and better environmental outcomes from the phalaris/white clover treatment (Scott *et al.* 2000). In part, this was brought about by increasing the level of nitrogen in the upper soil profile without resulting in more nitrate leaching from deep in the profile (Chen *et al.* 1999). Further, the phalaris/white clover allowed the accumulation of more soil water in the upper soil profile as well as allowing root activity to dry soil down deeper in the profile (McLeod *et al.* 2006). This meant that in dry autumns, perennial grasses combined with legumes were able to extract

more soil water and hence continued to produce some green leaf even under dry conditions. These factors led to considerably greater pasture growth from the phalaris/white clover treatment which supported a higher stocking rate without penalising per head production. The addition of white clover also increased the persistence of the phalaris and increased the uniformity of utilisation of the entire paddock.

Conclusions and Recommendations

Pastures based on persistent, deep-rooted, fertiliser-responsive, perennial grasses combined with persistent legumes are more sustainable and profitable than grass-based pastures. If these grasses are declining in pastures, this trend may be reversed by re-introducing a persistent legume component through direct drilling or sod seeding.

Legumes have an important role to play in pastures by biologically fixing atmospheric nitrogen (up to 150 kg N/ha/yr in good seasons) for eventual use by grasses to the benefit of cost-effective production of livestock protein with good environmental outcomes. Better soil nitrogen levels increase winter growth of pastures and hence lessen the need for expensive fodder supplements. In addition, legumes enhance the digestibility and protein content of the grazing ruminant diet. This usually results in less intake required for a given amount of milk, meat or wool produced and can result in reduced methane emissions.

Management to encourage legume persistence includes nutrition and grazing management. Legumes especially require adequate levels of soil phosphorus, sulphur and molybdenum. Whilst perennial grasses are favoured by grazing systems employing short graze and long rest periods, the reverse is true for many pasture legumes. Grazing management and the manipulation of stocking rate are essential tools to help ensure that desirable pasture species are not overgrazed to the point of being lost from pastures.

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References

Anonymous, 2009 Trends in Atmospheric Carbon Dioxide - Mauna Loa. (US National Oceanic & Atmospheric Administration), http://www.esrl.noaa.gov/gmd/ccgg/trends/.

Chen, W, Blair, G, Scott, J, Lefroy, R 1999 Nitrogen and sulfur dynamics of contrasting grazed pastures, *Australian Journal of Agricultural Research* 50, 1381-1392.

McLeod, MK, MacLeod, DA & Daniel, H 2006 The effect of degradation of phalaris plus white clover pasture on soil water regimes of a Brown Chromosol on the Northern Tablelands of NSW, Australia, *Agricultural Water Management* 82, 318-342.

Scott, JM, Hutchinson, KJ, *et al.* 2000 Quantifying the sustainability of grazed pastures on the Northern Tablelands of New South Wales, *Australian Journal of Experimental Agriculture* 40, 257-265.